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GB 1309794 A GB 0853926 A

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# (54) Rubber gloves

(57) Rubber gloves are made by irradiating rubber latex containing a sensitizer with ionizing radiation to effect cross-linking. A glove shaped former is then dipped into the irradiated material and dried. The sensitizer can be a mono- or di-unsaturated monomer, such as 1,3-butylene glycol diacrylate. The rubber gloves are capable of maintaining stable quality without any time elapsing deterioration and of preventing any pollutive exhaust gases such as SOx, NOx, hydrogen cyanide, carbon monoxide and the like when old rubber gloves are burned in the scrap treatment in an incinerator.

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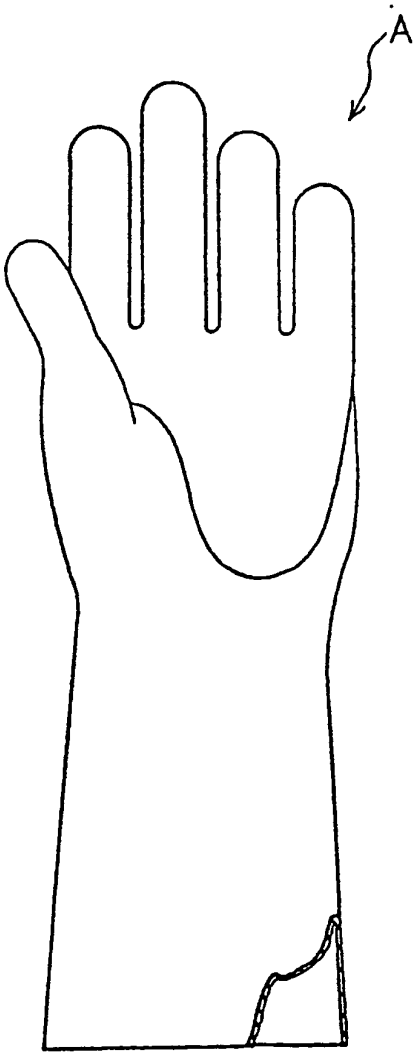
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# RUBBER GLOVES

## BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a rubber gloves and more particularly relates to the rubber gloves made of an improved rubber material processed by irradiation of ionizing radiation but not depend on any other conventional process such as sulfur vulcanization.

2. Description of the Prior Art

Conventionally, the rubber gloves is made by dipping a pair of hand shaped formers into rubber latex admixed with vulcanizing agent such as sulfur and activator such as zinc oxide and the like, and then dried in a vulcanization oven.

This conventional process has, however, such disadvantage that fitting for hand when wearing or after wearing these gloves often become uncomfortable in the fitness of wearing the gloves according to a time elapsed since the vulcanization gradually advances continuously beyond the optimum cure even after the vulcanization had been processed, consequently it causes a deterioration of quality according to time elapsed.

As another disadvantage, the conventional type rubber gloves are prohibited to be burned out in residence area in the scrap treatment of old gloves because of emitting a pollutive smoke or poisonous gases such as sulfur oxid (SOx), nitrogen oxide(NOx), hydrogen cyanide , carbon monoxide and the like.

## SUMMARY OF THE INVENTION

In carrying out the present invention in one preferred mode, it provides a raw material mixture consisting of mainly natural rubber latex and, as an additives, a sensitizer on radiation cross-linking which accelerates the cross-linking effect within the raw material after processed by irradiating an ionizing radiation at the raw material, wherein imparts an equivalent or more excellent properties of rubber material for making rubber gloves without any conventional admixtures as described previously in the prior art. Upon completion of the cross-linking process by irradiation on the raw material, which the processed raw material consists of natural rubber latex mainly, a pair of hand shaped formers are dipped into the processed raw material for forming a thin film adhered around the formers wherein pair of the rubber gloves are made after drying process for only solidification but not any the conventional such as the vulcanization described in the prior art.

## OBJECTS AND ADVANTAGES OF THE INVENTION

Accordingly, It is a general object of the present invention to provide a stable rubber material having more better elasticity for the rubber gloves to be capable of maintaining a prescribed quality without any time elapsing deterioration during a long period.

It is a more specific object of the present invention to

provide a processed raw material consisting of a natural and/or synthetic rubber latex with a sensitizer on radiation cross-linking as an additives for accelerating the radiation cross-linking effect by irradiating an ionizing radiation at the raw material without any conventional admixture such as sulfur and zinc oxide, whereby to assure a constant high quality for long period without any deterioration of the quality caused by advancing the vulcanization effect after dipping formation of a products such as rubber gloves due to the time elapsed.

It is another object of the present invention to provide a processed raw material with such properties which has a lower modulus, suitability for fine work and ease of usage in delicate work without undergoing fatigue.

It is still another object of the present invention to provide a non-pollutive rubber material for making the rubber gloves when it is burned in an ordinary incinerator located in residence area, whereby to make possible to burn the rubber gloves in the scrap treatment without any environmental pollution.

It is a further object of the present invention to provide a non-pollutive material of a rubber gloves which is capable of reducing utmost an ashes contents from an incinerator after burning treatment because of no content of any metallic oxide as conventional vulcanizing method, whereby is capable of preventing any plugging up of ceramics filter of the incinerator during the burning treatment becaus of no ashes remained.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a plan view for showing a practical example composed of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in detail to the drawings, a rubber glove(A) has an well known shape and structure as shown in Fig.1, which is made of a rubber latex as main component. Into this rubber latex, some amount of sensitizer on radiation cross-linking is admixed with, which can accelerate the cross-linking effect within the component of the rubber latex by irradiating an ionizing radiation upon the rubber latex, wherein a processed rubber latex has been made as a main raw material. Into this main raw material, a gloves former is dipped for forming a glove shaped film with sequent drying process. This is the outline of the present invention.

In the outline, as next it is referred to the chemical composition of the above main raw material, which is the highlight of the present invention. As an initial rubber material, it provides a natural rubber latex or synthetic rubber latex in which have a main component from polyisoprene. This rubber latex is utilized by itself alone or combined with another suitable admixture such as rubber softner, stabilizer, anti-oxidant, filler, reinforcer, tackifier, pigment and the like according to the necessity for the composition of the raw material.

As to the sensitizer on radiation cross-linking, this agent has a function to accelerate the cross-linking effect when the rubber latex and/or latex mixture is processed by irradiating the ionizing radiation. It is noted that originally the cross-linking effect can be generated into a plane rubber latex by only irradiating the radiation without any additives of another mixture, however, according to the addition of the sensitizer, the cross-linking effect can be accelerated effectively by the radiation, consequently it can save the radiation amount and its irradiating time at the rubber latex. In this way, the processed raw material has been provided by adding the sensitizer and then irradiated by the ionizing radiation.

Referring now further in detail to the specific composition of the sensitizer on radiation cross-linking, which comprising:

a polyfunctional monomers which contain two polymerizable unsaturated C=C bond in a molecule such as the followings;

(a) 1,3-butylene glycol diacrylate,

(b) 1,3-butylene glycol dimethacrylate,

(c) 1,6-hexanediol diacrylate,

(d) 1,6-hexanediol dimethacrylate,

(e) neopentyl glycol diacrylate,

(f) neopentyl glycol dimethacrylate and the like, and/or

a monofunctional monomers which contain one polymerizable unsaturated C=C bond in a molecule such as the followings;

(a) ethylacrylate,

(b) n-butylacrylate,

(c) n-hexyl acrylate,

(d) 2-ethylhexyl acrylate and the like.

The above two groups, that is, these groups of polyfunctional and monofunctional monomers are suggested as the sensitizer on radiation cross-linking of the present invention, and also suggested to combine 1 to 20, preferably 2 to 10 parts of weight of the sensitizer with 100 parts of weight of the rubber latex fraction.

As to the anti-oxidant which is one of admixture, it is admitted to use an well known type anti-oxidant in the art into the present invention. Particularly it can specify "dithiocarbamate type agent", which has been well known as a vulcanization accelerator in the conventional, however, which is available as one of anti-oxidant in the present invention.

In the combining rate of the anti-oxidantis into the rubber latex, it is suggested that 0.5 to 2.0 parts of weight of the anti-oxidant is preferable against 100 parts of weight of the rubber latex. As the timing of adding the anti-oxidant into the rubber latex, it is required to add after processed by the radiation since such the anti-oxidant will lose its effect of the anti-oxidant due to the separation of the component by the irradiation of the ionizing radiation such as gamma ray and the like. It is well known that such the ionizing radiation includes $\alpha$-rays, $\beta$-rays, $\gamma$-rays, x-rays, electron beam and the like, particularly $\gamma$-rays, x-rays and electron beam are

practical in industry. It is not necessary to specify the nuclide of the radioisotope in the present invention but it can suggest that Co-60 (cobalt 60) is practical in the industry. It is also not necessary to define the exposure of the radioisotope but it can suggest that the range between 0.5 to 10 Mrad is practical and between 1.0 to 8 Mrad is preferable.

As described in the above, by irradiating the ionizing radiation at the rubber latex, the processed raw material for forming the rubber gloves(A) of the present invention is obtained. According to the necessity, it can add well known type admixture used ordinary in the art such as a rubber softner, a stabilizer, an anti-oxidant, a filler, a reinforcer, a tackifier, pigment and the like into the rubber latex.

Referring now in detail to one example of the process for making a rubber gloves by dipping method into the above mentioned processed raw material, one example of the process is shown as follows:

(a) Preparation of the former;

(b) To dip the formers into coagulant solution. The purpose of the coagulant is to produce a greater deposit thickness than is achieved by "straight" latex dipping;

(c) To dip the former into the main material;

(d) Main drying of the latex film with the former(at 80°C for 20 minutes);

(e) To strip the film having a glove shape from the former;

(f) To leach the gloves into a dilute alkaline solution(composing of an ammonia, a sodium hydroxide, a potassium hydroxide

and the like) so as to extract the coagulant solution and the others;

(g) Treatment of preventing the adhesion of film surface; and

(h) Final drying(at 80°C for 60 minute).

In the above example of the process, which utilizes the processed raw material by the radiation for making the rubber gloves, it is noted that there is no difference between the present invention and the conventional process under vulcanization except for the composition of the raw material and the drying conditions.

Referring now in detail to the difference in the composition of the raw material between the present invention and the conventional under vulcanization, it is characterized in that the composition of the present invention has not any additives such as sulfur, zinc oxide and the like as a vulcanization accelerator, instead it substitutes the cross-linking effect on radiation for the conventional vulcanization effect.

This is one of the difference and another difference resides in the drying process between both raw materials, that is, in the conventional it takes approximately 60 minute at 80°C because of additional vulcanization process in a vulcanization oven but in the present invention it takes only approximately 20 minute at 80°C because of no requirement of the vulcanization.

In the above fact, it is clear that the present invention has advantages in that no additives ar required into the rubber lat x, thus can save the additional cost of adding conventional

type various additives, at the same time it can save the drying time in the process.

In addition, the present invention has further advantage when used gloves are scrapped. Because the conventional type rubber gloves made from vulcanization are prohibited to throw into fire due to the generation of pollutive gases such as SOx which causes air pollution or acidic rain and further causes the corrosion of incinerator's inside wall, NOx which is generated from organic nitrogen compound by photochemical reaction and causes a photochemical smog in megalopolis, hydrogen cyanide, carbon monoxide and the like.

In contrast it is clear that the present invention is almost free from the aforementioned air pollution because the above organic nitrogen compound is degraded by the irradiation of ionizing radiation in the present invention and the other additives admixed in the rubber latex are also extracted in the dilute alkaline solution during its finishing process so that no pollutive gases are exhausted when any scrapped gloves are burned in the incinerator.

The following Table A shows the comparison of analysis between the conventional method which utilizes the vulcanization with various additives and the preferable example practiced in the present invention:

TABLE A

| Items | Conventional method | Present invention |
|---|---|---|
| SOx | 20 mg/g | less than 2.0 mg/g |
| NOx | 4.3 mg/g | 2.4 mg/g |
| Hydrogen cyanide | 0.015-0.025mg/g | 0.002 mg/g |
| Carbon monoxide | 300 mg/g | 56 mg/g |
| Ashes | 2.2% | 0.5% |
| Zinc content | 10.000 ppm | 77.2 ppm |
| Oxigen index * | 16.8 | 15.8 |

* Oxigen index shows a necessary oxigen concentration, therefore, shows also a combustion efficiency.

The above TABLE A shows the results of combustion analysis of the sulfur vulcanization gloves and the radiation cross-linking gloves. TABLE B shows the physical properties of the rubber gloves.

TABLE B

| Item | Sulfur vulcanization type | Radiation cross-linking type |
|---|---|---|
| 500 % modulus * | 37 - 38 kgf/cm² | 27 kgf/cm² |

* 500 % modulus: Modulus of elasticity at 500 %.

As shown in the above two tables, it is apparent that the present invention achieves to make such a rubber gloves having excellent properties of non-pollution ability and tensile strength owing to the process of irradiating an ionizing radiation upon the raw material consisting of natural rubber latex or synthetic latex by adding a sensitizer on radiation cross-linking into the latex for accelerate the cross-linking effect therein by the irradiation, thus a processed raw material is composed thereof, a dipping former is dipped into the processed raw material for forming the rubber gloves wherein the rubber gloves is dried after stripping from the former.

The following composition is a typical composition of the raw material:

(a) Natural rubber latex (rubber contents) 100 parts latex solid.

(b) 1,3-butylen glycol diacrylat 5 parts

(c) 2,2'-methylene-bis-(4-methyl
6-tert-butylphenol) 1 parts

In the above composition, it is prohibited to admix these composition(b) and (c) into the natural rubber latex(a) at same time. The mixing process should be separated into two stages, that is, firstly the composition(b) is mixed into the latex(a) and then they are agitated for one hour, wherein the latex(a) is irradiated at 5 Mrad(mega rad) with $\gamma$-rays from Co-60 (cobalt 60 source) so as to compose the raw material, thereafter the composition(c) is added to the raw material produced by gamma-rays irradiation.

The present invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as descriptive and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalence of the claims are therefore intended to be embraced therein.

WHAT IS CLAIMED IS:

1. Rubber gloves,

comprising:

an unprocessed raw material provided to consist of a rubber latex mainly with an additive of sensitizer on radiation cross-linking;

said sensitizer on radiation cross-linking provided to admix into said rubber latex for accelerating said radiation cross-linking effect within the composition of said rubber latex by irradiating an ionizing radiation at the admixture between said rubber latex and said sensitizer on radiation cross-linking; and

a processed raw material provided from said unprocessed raw material upon the completion of irradiating said ionizing radiation, wherein a glove shaped thin film is made by dipping a glove shaped former into said processed raw material thereto solidified through drying process.

2. Rubber gloves according to claim 1, wherein said rubber latex consists of a natural rubber latex and/or a synthetic rubber latex.

3. Rubber gloves according to claim 1, wherein said sensitizer on radiation cross-linking is selected from the group of poly functional monomers which contain two pplymerizable unsaturat d C=C bond in a molecule and/or the group of monofunctional

monomers which contain one polymerizable unsaturated C=C bond in a molecule, wherein these sensitizers are added to said rubber latex from 1 to 20 parts, preferably 2 to 10 parts respectively into 100 parts rubber latex solid.

4. Rubber gloves according to claim 1, wherein said ionizing radiations are admitted to select from $\alpha$-rays, $\beta$-rays, $\gamma$-rays, X-rays, electrone beam, particularly Co-60 source is preferable as nuclides of radioisotope.

5. Process for making rubber gloves, comprising the steps of:
providing an unprocessed raw material consisting of a rubber latex mainly with an additive of sensitizer on radiation cross-linking;
admixing said sensitizer on radiation cross-linking into said rubber latex for accelerating said radiation cross-linking effect within the composition of said rubber latex by irradiating an ionizing radiation at the admixture between said rubber latex and said sensitizer on radiation cross-linking; and
providing a processed raw material obtained from said unprocessed raw material upon the completion of irradiating said ionizing radiation, wherein making a glove shaped thin film by dipping a glove shaped former into said processed raw material thereto solidifying it through drying process.

6. Rubber gloves substantially as hereinbefore described with reference to the accompanying drawing.

7. Process for making rubber gloves substantially as hereinbefore described.



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